Operating Experience Weekly Summary 97-45

October 31 through November 6, 1997

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EVENTS

1. UNEXPECTED RELEASE OF NITROGEN DIOXIDE DURING RESIN REGENERATION

On October 28, 1997, personnel at the Savannah River Site reported the inadvertent release of nitrogen dioxide from a process vessel vent stack at the Receiving Basin for Offsite Fuels. An engineer saw a yellow-brown vapor rising from the stack and, believing this was abnormal, reported it to the facility manager. Operators were regenerating resin at the time the release was discovered. They terminated the process after the engineer reported seeing the vapor, and the discharge from the vent stopped. Investigators determined that an operator had added more reactant to a waste tank than the procedure specified on the previous day. This reacted with nitric acid from the regeneration process and produced nitrogen dioxide. Although there were no adverse safety or health problems and no radiological release, exposure to nitrogen dioxide fumes can be harmful to the respiratory and cardiovascular systems. The short-term exposure limit for nitrogen dioxide recommended by the National Institute for Occupational Safety and Health (NIOSH)/OSHA is 1 ppm, with an immediately dangerous to life or health limit of 50 ppm. (ORPS Report SR--WSRC-RBOF-1997-0012)

The facility manager determined that on October 27, an operator added sodium nitrite to the waste tank, which already contained treated wastewater. The procedure specified the addition of 2 inches of sodium nitrate solution to the waste tank. When the operator saw the sodium nitrate tank level drop by 2 inches, she instructed the operator running the addition pump to stop the pump. However, the operator at the tank did not immediately close the tank outlet valve, allowing 7 more inches of sodium nitrite to be added to the waste tank. The operator immediately notified her supervisor. The supervisor contacted the operations engineer and the facility manager.

On October 28, operators transferred the wastewater to the tank farms with the approval of waste management personnel. Later that day, during the resin regeneration process, operators added a 5 percent nitric acid solution to the waste tank. However, the tank contained a heel from the waste-water transfer. The heel contained wastewater and the additional sodium nitrite, which reacted with the nitric acid to generate nitrogen dioxide. The facility manager stopped the regeneration process, closed access to the facility roof, notified the operations center, and contacted medical personnel. Radiological controls operations personnel surveyed the stack filter paper and detected no contamination higher than background. Engineers will evaluate the stack emission before allowing access to the roof.

The facility manager conducted a critique of the event. Critique members determined that the steps and sub-steps before the action step in the procedure instructing the operator to isolate the sodium nitrate tank were not applicable to the sodium nitrate evolution. The operator, who had never performed this evolution, read through the non-applicable steps and marked them “N/A” (not applicable) while the tank level was decreasing. Corrective actions include (1) re-briefing the operator on performing the evolution, (2) reviewing the adequacy of the pre-job brief regarding discussion of non-applicable steps, and (3) reviewing the adequacy of the operating procedure.

NFS reported numerous events in the Weekly Summary where operator errors occurred while following procedures. Following are some examples.

- Weekly Summary 97-37 reported that alarm technicians at Rocky Flats inadvertently actuated a plenum deluge system while performing an annual battery load-test on a fire panel. The deluge system released 2,000 gallons of water into the plenum and 500 gallons of water leaked from the plenum into adjacent

contamination areas. Investigators determined that the technicians used a generic procedure, supplemented by an uncontrolled list of the associated systems connected to the tested alarm points. They also determined that the technicians failed to isolate the plenum deluge system because it was not identified on the list. (ORPS Report RFO--KHLL-NONPUOPS1-1997-0009)

- Weekly Summary 96-48 reported that an operator at the West Valley Site caused main plant process ventilation to shut down while he performed a valve line-up on an instrument air dryer. The operator closed a bypass valve before opening the supply air valve. The operator used the correct procedure; however, the procedure did not give a specific, sequenced valve line-up. (ORPS Report OH-WV-WVNS-1996-0012)

This event illustrates the importance of ensuring that non-applicable procedure steps are understood and addressed before conducting the evolution. If at all possible, procedures should be constructed to minimize directing the user to other sections within the procedure or to other procedures. This can prevent operator errors. Also, operators who have not performed an evolution should demonstrate their proficiency under the instruction of an experienced operator. The unexpected release of nitrogen dioxide could have had serious consequences. An evacuation occurred at the Oak Ridge K-25 Site after nitrogen dioxide fumes entered a building ventilation system and several window air conditioning units during hazardous waste-handling activities. Fourteen people were treated for headaches and eye irritation. (Weekly Summary 95-20; ORPS Final Report ORO--MMES-K25GENLAN-1994-0023)

Facility personnel who write procedures should review the following Order and standard to ensure that procedures include the appropriate level of detail.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, section XVI, states that procedures should provide appropriate direction to ensure that the facility is operated within its design basis and should be used effectively to support safe operation of the facility. The Order also states that procedures should be written so that they can be easily used without making mistakes. Procedures should be organized and presented for convenient use by operators. The sequence of procedural steps should conform to the normal or expected operational sequence. Training on this sequence, reinforced by procedures that show the same sequence, serve to improve operator performance by developing patterns of action that are more easily remembered.

- DOE-STD-1029-92, *Writer's Guide for Technical Procedures*, establishes the recommended process for developing technical procedures that are accurate, complete, clear, and consistent. The guide provides guidance for developing a procedure basis; planning, organizing, and structuring the procedure; developing content and establishing format; and writing action steps. Section 4.1 discusses the basic elements of writing action steps; section 4.11 discusses action steps that direct users elsewhere and the potential problems this may cause.

KEYWORDS: operations, procedures, training and qualification, chemical reaction,

FUNCTIONAL AREAS: Operations, Procedures, Training and Qualification

2. HOT SLAG IGNITES FLEXIBLE EXHAUST DUCT

On November 3, 1997, personnel at a commercial nuclear hot-cell facility reported a small fire in some flexible exhaust duct to the Nuclear Regulatory Commission. Facility personnel believe the fire started when a piece of hot slag fell on the duct during the cutting of some steel plates being removed from a decommissioned hot cell. A spokesperson for the facility reported that the fire watch extinguished the fire, and personnel evacuated the facility. The fire watch was later hospitalized overnight for smoke inhalation. Investigators determined there was no release of radioactivity to the environment and no damage to the facility. This event is important because of the increasing number of DOE facilities that are transitioning to deactivation and decommissioning activities, thereby increasing cutting and welding operations. (NRC Event Number 33204)

A facility spokesperson reported that workers were cutting and removing steel plates in a decommissioned hot cell when hot slag from the cutting operation ignited the flexible exhaust duct. The spokesperson also reported that all smoke was filtered through the high efficiency particulate air filter ventilation system. The facility manager continues to investigate this event.

NFS reported welding events in several Weekly Summaries. The following are recent examples.

- Weekly Summary 97-40 reported that a safety engineer at the Savannah River Site observed several unsafe practices during welding operations and stopped the welding activities. He observed a number of safety violations, including fire watch violations; failure to use protective equipment; and combustible materials in the immediate area. (ORPS Report SR--WSRC-RMAT-1997-0009)

- Weekly Summary 97-20 reported that a laborer at Hanford caught the leg of his coveralls on fire while cutting steel plates when a piece of hot metal (slag) dropped into the folds of his clothing. (ORPS Report RL--BHI-REMACT-1997-0005)

- Weekly Summary 97-11 reported that a welder at the Oak Ridge K-25 Site was fatally burned when two layers of his anti-contamination clothing and coveralls caught fire, engulfing him in flames. All of the clothing was cotton. A DOE Type A accident investigation determined that sparks or molten metal (slag) from the cutting operation ignited his clothing. (Type A Accident Investigation Board Report on the February 13, 1997, Welding/Cutting Fatality at the K-33 Building, K-25 Site Oak Ridge, Tennessee, ORPS Report ORO--LMES-K25GENLAN-1997-0001)

These events illustrate the potential dangers involved in welding, cutting, and grinding activities. These activities pose safety and health hazards to workers under any circumstances, but they pose unique hazards to workers performing decontamination and decommissioning activities. Fire prevention is an important consideration for these activities. Open flames, electric arcs, hot metal, sparks, and spatter are ready sources of ignition.

Managers at DOE facilities undergoing deactivation need to ensure that vendors and subcontractors understand local work control practices and the importance of following safety requirements. Several publications provide guidance on welding and cutting safety and on reducing fire hazards. The following publications contain many general and specific recommendations and should be consulted by the appropriate facility personnel.

- Chapter 12 of DOE/EM-0142P, *Decommissioning Handbook*, March 1994, DOE Office of Environmental Restoration, provides requirements for worker protection during decontamination and decommissioning activities. It states that worker protection is an important element of any project. The handbook divides worker protection issues into three categories: (1) protection from radiation; (2) protection from toxic and hazardous materials; and (3) protection from traditional industrial safety hazards. The handbook further states that DOE decommissioning activities

may combine hazards not commonly encountered elsewhere (such as industrial safety hazards and radiological hazards) and lists OSHA regulations that apply to decommissioning, as well as key elements of a health and safety program. Section 12 of the handbook states that extra precautions are required for worker safety because hazards in the facility may be unknown and many activities are infrequently performed.

- DOE/EH-0196, Bulletin 97-3, "Fire Prevention Measures for Cutting, Welding, and Related Activities," describes the fire protection measures necessary for welding and cutting activities. Guidelines outlined in the bulletin include provisions for (1) management commitments, (2) job safety analysis, (3) permits, (4) isolation/protection of combustibles, (5) personnel protective equipment, (6) dedicated fire watcher(s), (7) manual fire-fighting equipment, (8) emergency services, (9) site-specific hot work policies and procedures, and (10) information sharing.

- 29 CFR 1910.252, *General Requirements*, states that "cutting or welding shall be permitted only in areas that are or have been made fire safe." Section (a)(2)(vii) requires relocating combustible materials at least 35 feet from the work site. Where relocation is impracticable, combustibles shall be protected with flame-proofed covers or otherwise shielded with metal or asbestos guards or curtains. Sub-part I, Appendix B, "Non-mandatory Compliance Guidelines for Hazard Assessment and Personal Protective Equipment Selection," provides compliance assistance to implement requirements for a hazard assessment and selection of personal protective equipment. It states that walk-downs of the work areas should be performed to identify hazards before work begins.

- The National Fire Protection Association, *Industrial Fire Hazards Handbook*, Second Edition, provides guidance for the removal and protection of combustibles during welding and cutting activities.

- American National Standards Institute (ANSI) Standard Z49.1, *Safety in Welding, Cutting and Allied Processes*, paragraph 6.2.2, requires a fire watch when combustible materials are closer than 35 feet to the point of operation. Paragraph 7.2.3 requires ducts used for local exhaust ventilation to be constructed of non-combustible materials and inspected to ensure proper function and to ensure that the internal surfaces are free of combustible residuals.

- The following publications can be obtained from the American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126 or by calling (305) 443-9353.

  Brazing Safely, 1992.

  Arc Welding Safely, 1988.

  Oxyfuel Gas Welding, Cutting, and Heating Safety, 1992.

  Safe Practices, 1992.

  Safety in Welding, Cutting and Allied Processes, ANSI/ASC Z49.1-1988.

DOE/EH-0197, Safety Bulletin 97-3, can be obtained available via the Internet at URL http://tis.eh.doe.gov:80/docs/bull/links.html. OSHA regulations can be found at URL http://www.osha-slc.gov/. *Industrial Fire Hazards Handbook*, 2nd ed., and *Fire Prevention in Use of Cutting and Welding Processes*, Standard 51B, can be obtained from the National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, Massachusetts 02269-9101. NFPA codes and standards can be found at URL http://www.nfpa.org/.

KEYWORDS: contamination, decontamination and decommissioning, fire, hot cell, cutting

FUNCTIONAL AREAS: Decontamination and Decommissioning, Work Planning, Industrial Safety

3. WRONG MOTOR CONTROL CENTER LOCKED OUT/TAGGED OUT

On October 22, 1997, at the Hanford Site Plutonium Reclamation Facility, facility personnel discovered that electricians had locked out and tagged out the wrong motor control center in May 1997 because system drawings were incorrect. The electricians were performing work on a vacuum system that required actuation of a pump. However, the pump would not start; so they decided to troubleshoot the problem. They determined that the motor control center supplying power to the pump was locked out/tagged out instead of a motor control center that workers intended to lock and tag. Investigators determined that this event occurred because the motor control center was modified in 1995, and no one revised the drawings. Facility modifications without proper controls can result in hazards to individuals performing the work and in unauthorized configuration changes that lower safety margins. (ORPS Report RL--PHMC-PFP-1997-0042)

Investigators reported that electricians locked out and tagged out the motor control center cabinets after a chemical explosion in May 1997. The electricians needed to isolate power to the room to perform clean-up activities. They performed a zero energy check, but believed it was incorrect because of the extensive explosion damage. Therefore, they performed zero energy checks on each component each time they began work. While investigating the vacuum system problem, the electricians noticed that the labels on the motor control center cabinets did not match the loads identified on the drawings. They concluded that the wrong motor control center was locked out in May.

Investigators determined that the work package to isolate power to the room was based on incorrect drawings. They also determined that the drawings were correct before the 1995 modifications, but the tracking system failed to ensure drawings were updated. Figure 3-1 is a simplified schematic of the as-found configuration compared to the drawing configuration.

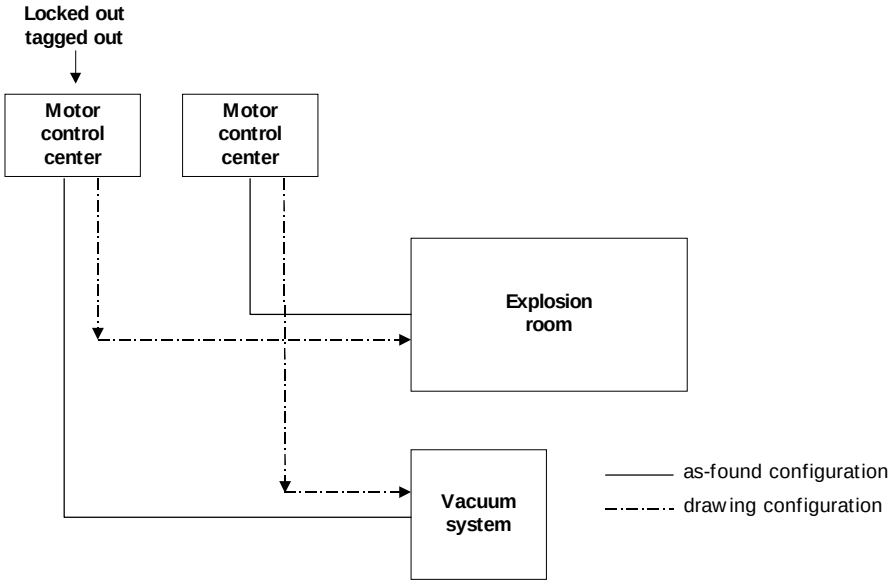

Figure 3-1. Simplified Configuration Schematic

NFS has reported on inadequate configuration controls in several Weekly Summaries. Following are some recent examples that occurred at the Hanford Site.

- Weekly Summary 97-15 reported that an electrician at Hanford inadvertently activated two radiation alarms and shut down a building exhauster when he opened a circuit breaker identified as the power supply for some heat-tracing tape. Investigators determined that the panel labeling and the drawing identified the correct isolation point for the heat tracing. However, further evaluation revealed that the wiring was not in accordance with the drawings. (ORPS Report RL--PHMC-TANKFARM-1997-0035)

- Weekly Summary 97-04 reported that an electrician at Hanford received minor flash burns when he attempted to reconnect energized, 480-volt power leads to a motor control center main breaker. The electrician and a co-worker believed the circuit was de-energized based on their interpretation of electrical system drawings and an earlier zero energy verification. Investigators determined there was an inconsistency between the electrical system configuration and the system drawings. (ORPS Report RL--PHMC-S&W-1997-0001)

- Weekly Summary 96-26 reported a near-miss at Hanford when two electricians were performing preventive maintenance on four glycol cooling fans. The electricians de-energized and locked out four cooling fans in a bank of eight, and performed a zero energy check. While the electricians were preparing to work on two of the fans, four of the fans started automatically from a thermostat. The technicians thought that they had tagged out and de-energized two of the fans that started. Investigators determined that they tagged out the wrong fans because the equipment was mislabeled and the drawings were incorrect. (ORPS Report RL--WHC-TANKFARM-1996-0041)

OEAF engineers searched the ORPS database for events with a direct cause of drawing, specification, or data error and found 216 events. Figure 3-2 shows the root causes for these events. A review of these occurrences shows that managers reported 45 percent of the root causes as design problems, with 84 percent attributed to drawing, specification, or data errors. The remaining design problems were attributed to inadequate work environment or inadequate or defective design. In addition, they reported 38 percent of the root causes as management problems. Of the management problems, 56 percent were attributed to inadequate administrative control or policy not adequately defined, disseminated, or enforced; and 21 percent were attributed to work organization/planning deficiency.

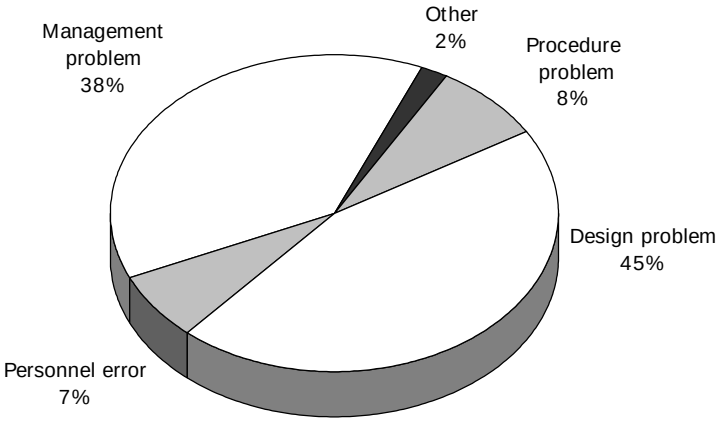

Figure 3-2. Root Causes for Drawing, Specification, or Data Errors[1]

These events underscore the importance of correct drawings and a disciplined configuration management program. According to DOE facility representatives, a facility-wide upgrade of all drawings was performed in 1993. They believe the systems in place to track and monitor subsequent modifications and ensure incorporation of changes into documents failed to prevent this event. When facility managers become aware that their facility drawings may be incomplete or inaccurate, additional safety steps should be incorporated into work controls and maintenance activities. Facility managers should also ensure that configuration changes are incorporated into facility documents, equipment is properly labeled, and assessments are conducted to verify the configuration management program effectiveness.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, "Control of Equipment and System Status," provides guidance for the control of equipment and systems in DOE facilities. DOE facilities are required to establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing activities. Chapter XVIII, "Equipment and Piping Labeling," states that labels should be consistent with the information contained in facility documentation. The chapter also addresses the verification of labels.

- DOE-STD-1073-93-Pt.1 and -Pt.2, *Guide for Operational Configuration Management Program Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, states that physical configuration assessments or walk-downs should be performed for representative sample structures, systems, and components within the facility to determine the degree of agreement between the physical configuration and the configuration on the facility documentation. Physical walk-downs should be included as part of the programmatic assessments conducted during initial assessments, post-implementation assessments, and periodic effectiveness assessments.

- DOE-STD-1044-93, *Guide To Good Practices for Equipment and Piping Labeling*, section 4.4.2, states that labels should be independently verified to ensure that the

[1] OEAF engineers searched the ORPS database using the graphical users interface for reports with a direct cause code "4D" (drawing, specification, or data errors) and found 216 events. Based on a random sampling of 25 events, OEAF engineers determined that each slice is accurate within ± 1 percent.

label is properly attached to the correct component and that all label information is correct. This standard also provides valuable information on label information, placement of labels, color-coding, readability, and means of attachment and placement.

KEYWORDS: electrical hazard, configuration control, work planning

FUNCTIONAL AREAS: Electrical Maintenance, Configuration Control

4. TECHNICIAN SHOCKED WHEN CAPACITOR DISCHARGES

On October 30, 1997, at Sandia National Laboratory, a technician received a shock from a partially charged capacitor when he removed a cable from a fixture in a fluorinert-filled test tank. The technician inadvertently touched the coax connector shell at one end of the cable to a resistor in the circuitry while his hand was on the tank. This completed the circuit to ground and allowed the capacitor to discharge. The technician was not injured, and there was no equipment damage. Investigators later determined that someone added the capacitor to upgrade the system 3 months earlier and did not revise procedures to reflect the upgrade. Failure to update procedures and provide a method of discharging the capacitor before beginning work resulted in the technician being shocked. (ORPS Report ALO-KO-SNL-1000-1997-0008)

Investigators determined that the technician had previously removed cables in the same manner, but the coax connector had not contacted the resistors. Investigators learned that when another technician completed a series of tests for a neutron tube the previous day, he turned off the system power. They also determined that the primary circuitry in the test system has a bleed-off resistor to de-energize it, but there is no bleed-off resistor for the tank side of the system. The facility manager suspended operations until procedures are changed to reflect the upgrade and directed engineers to complete an evaluation to determine the impact of system upgrades. He also directed electricians to install a grounding rod to bleed-off power from the capacitor.

NFS has reported on electrical shocks from capacitor discharges in several Weekly Summaries. Following are some examples.

- Weekly Summary 97-17 reported that a visiting engineer at Los Alamos National Laboratory received an electrical shock when he reached into a damaged capacitor case. The engineer was to direct a post-mortem inspection on the capacitor as part of a project to test-to-failure large high-energy storage capacitors in a high-voltage set-up. A special electrical work permit governing the activities for the post-mortem did not allow the engineer to perform hands-on activities. (ORPS Report ALO-LA-LANL-PHYSCOMPLX-1997-0001)

- Weekly Summary 97-08 reported that a technician at the Los Alamos National Laboratory Dynamic Experimentation Facility violated a standard operating procedure and caused a capacitor to discharge three times when he started to work on a high-voltage connector in an equipment rack without de-energizing it or grounding the capacitor. Investigators believe the design of the high-voltage connector isolated the operator from electric shock because the handle of the connector sparks to ground inside the chassis. (ORPS Report ALO-LA-LANL-FIRNGHELAB-1997-0002)

- Weekly Summary 96-04 reported that a technician at the Los Alamos National Laboratory received a mild electrical shock while working in the prime power tank. This incident occurred while he was attempting to complete laser maintenance at the Radiographic Support Laboratory. Investigators determined that the standard operating procedure had not been revised to reflect hardware modifications to the

capacitor configuration. The modified configuration made the procedure ineffective and resulted in the shock. (ORPS Report ALO-LA-LANL-FIRNGHELAB-1996-0001)

OEAF engineers reviewed selected occurrences from the ORPS database from October 1, 1990 through September 30, 1997, for hazardous electrical occurrences and found 742 reports. More than half of the occurrences had a root cause of either management problems or personnel error. About 27 percent of the management problems resulted from inadequate administrative control; 26 percent resulted from inadequate policy dissemination and enforcement; and about 22 percent resulted from work-planning deficiencies. About 42 percent of the personnel errors involved failure to follow procedures, and 41 percent were inattention to detail. Taken together, the data indicates that nearly 70 percent of all occurrences could be eliminated by a well-trained, well-managed, attentive work force using good procedures. Figure 4-1 shows the distribution for hazardous electrical occurrences.

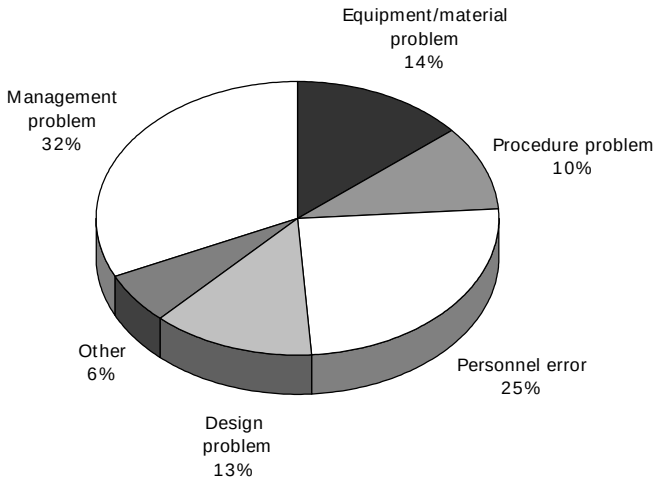

Figure 4-1. Root Causes for Hazardous Electrical Occurrences[1]

This event illustrates the importance of practicing proper change control and configuration control when equipment modifications are performed. The probability of craftsman error increases with the use of poorly written procedures or inaccurate drawings. Procedures should provide technical guidance to workers to help ensure that work is accomplished in a systematic and correct manner. This guidance must be technically accurate, complete, and up-to-date and must be presented in a clear, concise, and consistent manner that minimizes human error.

This event also demonstrates the importance of multiple, engineered barriers to prevent hazardous events such as electrical shocks or discharges. Although human performance, supported by procedures, policies, memoranda, or standing orders, is a standard barrier to prevent electrical shock events, the probability of prevention can be increased by adding physical barriers. Workers also need to be trained and made aware of the stored electrical energy and shock hazard of capacitive discharge.

Managers and supervisors in charge of job performance should ensure that hazards are identified and corrected. DOE facility managers should ensure that personnel understand the basics of work control practices and safety and health hazard analyses. Personnel in charge of system design changes should ensure that facility documentation, including drawings, is updated and accurate.

[1] OEAF engineers performed several interactive narrative searches for electrical events. Review of the reports identified 742 reports that we classified as hazardous electrical occurrences.

- DOE O 4330.4B, *Maintenance Management Program,* chapter 6, provides guidance for preparing and using procedures and other work-related documents that contain appropriate work directions. Section 6.2 states that experience has shown that deficient procedures, and failure to follow procedures, are major contributors to many significant and undesirable events.

- OSHA regulations in 29 CFR 1910.147, sub-part J, "General Environmental Controls," and in 29 CFR 1910.333, sub-part S, "Safety-Related Work Practices, " require discharging, short-circuiting, and grounding capacitors if stored electric power could endanger personnel.

- DOE/ID-10600, *Department of Energy Electrical Safety Guidelines*, chapter 2.0, states that capacitive devices may retain or build up a charge, so the circuit should be shorted or grounded.

- DOE-STD-1073-93-Pt.1 and Pt.2*, Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, provides guidelines and good practices for an operational configuration management program including change control and document control.

- The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that provide controls over hazards associated with a job. Barriers may be physical barriers, procedural or administrative barriers, or human action. The reliability of barriers is important in preventing undesirable events such as shocks. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in parallel to provide defense-in-depth and to increase the margin of safety. The Hazard and Barrier Analysis Guide provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

A copy of the *Hazard and Barrier Analysis Guide* is available from Jim Snell, (301) 903-4094, and may also be obtained by contacting the ES&H Information Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72/Suite 100, CXXI/3, Germantown, MD 20874.

KEYWORDS: capacitor, electrical, shock

FUNCTIONAL AREAS: Industrial Safety, Configuration Control, Hazards and Barrier Analysis

5. ESCORTS FAIL TO COMPLY WITH RADIOLOGICAL WORK PERMIT

On October 29, 1997, at the Savannah River Site, radiological control personnel observed three tour group escorts who did not have criticality neutron dosimeters as required by a radiological work permit. They also discovered that one escort was a non-radiological worker who had no thermoluminescent dosimeter. Another escort was Radiological Worker I trained, and the third was Radiological Worker II trained, but neither of them had signed the radiological work permit. Radiological control personnel issued a radiological deficiency report. This event is significant because the escorts did not comply with the permit requirement for dosimetry and did not comply with procedures by not signing the radiological work permit. The wearing of dosimetry provides indication of personnel exposure to radiation and assists in maintaining personnel doses less than administrative control levels. Escorts are responsible for the accountability and safety of visitors in their charge, and must ensure compliance with radiological procedures and policies. (ORPS Report SR--WSRC-REACK-1997-0010)

The escorts were providing a tour of a building for international visitors, including three female foreign nationals. Health physics personnel conducted a training briefing for the visitors, assigned them dosimetry, and had them sign the radiological work permit. Investigators determined that, at the last minute, to ensure someone would be available to escort the female visitors to the restroom, individuals assisting the tour group coordinator assigned three women as additional escorts. The women did not attend the tour-group briefing because they received the assignment too late to do so. Therefore, they did not receive criticality neutron dosimeters or sign the radiological work permit. Investigators also determined that the escorts were not familiar with the building and the areas being toured, bringing into question their escort qualifications.

NFS has reported numerous violations of radiological procedures and escort-related events in the Weekly Summary. Following are some examples.

- Weekly Summary 97-06 reported that an escort and five members of a tour group entered a posted radiological buffer area at Savannah River without signing the required radiological work permit. One group member entered the area without the proper dosimetry. The tour leader disregarded an entry posting because he incorrectly believed that the facility entry plan allowed them to enter without signing the radiological work permit. A corrective action was to evaluate the adequacy of the facility entry plan, including selection of tour guides and tour briefings. (ORPS Report SR--WSRC-REACP-1997-0001)

- Weekly Summary 96-49 reported that a contractor security officer at Savannah River entered a controlled area without signing the radiological work permit and without wearing the required dosimetry. Investigators determined the officer did not have radiation worker training. However, he had received Savannah River general site radiation training, which should have taught him to recognize the significance of postings and not to enter a radiologically controlled area. (ORPS Report SR--WSRC-ITP-1996-0041)

- Weekly Summary 95-04 reported that three off-site visitors, three operations escorts, and two other on-site personnel violated radiological control procedures during a tour of a building at Rocky Flats. An escort and visitor entered a locked high-radiation area without supplemental dosimetry as required by postings. Another escort opened a drum of depleted uranium in violation of the radiological work permit requirement for respiratory protection. (ORPS Report RFO--EGGR-NONPUOPS1-1995-0004)

OEAF engineers searched ORPS database from 1995 to present for violations of radiological work permits across the DOE complex and found 122 occurrences. Figure 5-1 shows that facility managers reported personnel error as the root cause for 54 percent of the occurrences. They also reported that management problems accounted for 38 percent of the violations. Further review shows that 50 percent of the personnel errors were reported as procedure not used or used incorrectly and 43 percent as inattention to detail. Inadequate administrative control accounted for 40 percent of the management problems.

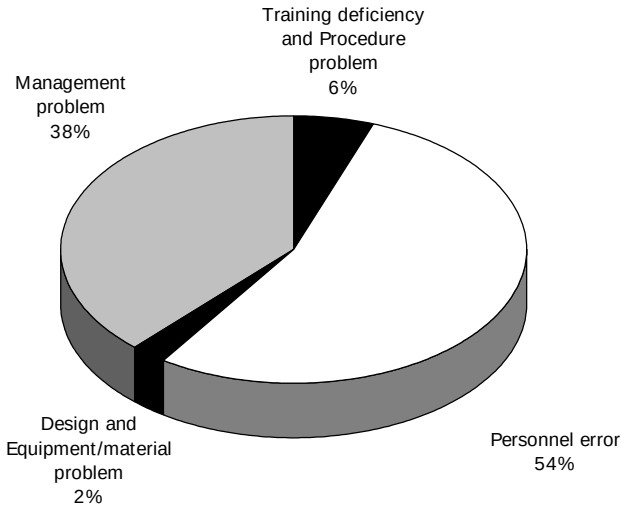

Figure 5-1. Distribution of Root Causes for Radiological Work Permit Violations[1]

This event points out the need for effective access control and proper selection of qualified and trained escorts. Escorts are provided to ensure visitors follow radiological controls and security requirements and to respond if they need assistance. Escorts should have appropriate knowledge to help visitors avoid contamination. Escorts also have the responsibility for ensuring that they, too, comply with radiological procedures.

DOE/EH-0256T, rev 1, *Radiological Control Manual*, article 336, "Visitor Entry Requirements," states that visitors with a demonstrated need to enter (1) radiological buffer areas, (2) radiation areas, (3) contamination areas, or (4) radioactive material areas may be allowed entry if access is controlled with a combination of radiological training and the use of escorts trained for the specific area. Several other articles in the manual address training requirements for visitors. Specifically, article 622, "Radiological Orientation of Visitors," and article 657, "Specialized Visitor Training for Tour Groups and Visiting Dignitaries, Scientists, and Specialists," identify training for visitors and tour groups and basic radiation protection concepts.

KEYWORDS: radiation protection, training and qualification, escort, tour guide, dosimetry, radiological work permit

FUNCTIONAL AREAS: Radiation Protection, Training and Qualification

6. LOCKOUT/TAGOUT VIOLATIONS

This week, OEAF engineers reviewed five recent lockout/tagout events. On November 2, 1997, at the Savannah River Site, facility personnel approved a valve lockout without adequately

[1] OEAF engineers searched the ORPS database using the graphical user interface for final reports from 01/01/95 to 11/06/97 with an all narrative of "radiological work permit" AND "violat*" and found 122 occurrence reports with 126 events. Based on a random sampling of 50 events, OEAF engineers determined that each slice is accurate within ±3.74 percent.

establishing and addressing system boundaries. On November 2, 1997, at the Fernald Environmental Management Project, a utility engineer discovered that a services interruption permit (similar to a lockout/tagout) had improper change authorizations. On November 3, 1997, at Sandia National Laboratory, an electrician removed a lockout and reconnected the electrical load without authorization. On November 3, 1997, at Oak Ridge National Laboratory, OSHA inspectors observed that millwrights had not re-verified a single-point lockout before resuming repair work. On November 3, 1997, at the Idaho National Engineering and Environmental Laboratory, maintenance mechanics installed a lockout/tagout on an instrument air line, then cut an adjacent but incorrect, air line. Lockout/tagout violations can result in injury to employees and loss of equipment configuration control. (ORPS Reports ALO-KO-SNL-NMFAC-1997-0016, SR--WSRC-SEPGEN-1997-0004, OH-FN-EDF-FEMP-1997-0048, ORO--ORNL-X10PLEQUIP-1997-0011, ID--LITC-SMC-1997-0007)

At the Savannah River Site, personnel were transferring 64 percent nitric acid between two facilities when facility personnel saw acid overflowing a tank in one location and leaking onto the floor in another. The facility manager held a critique. Critique members determined that the lockout/tagout for work on an acid drain header received an operations review but not an engineering review at one of the facilities. No one at the other facility reviewed the lockout/tagout package. Investigators determined that the lack of formal protocols for lockout/tagouts between facilities contributed to this occurrence.

At the Fernald Environmental Management Project, a utility engineer discovered that the services interruption permit used for a large tank movement was incomplete and that changes had been made without the proper authorizations. A construction coordinator obtained the original services interruption permit to de-energize overhead electrical lines so that work could be performed safely on nearby steam and condensate lines. Workers completed the work on the steam and condensate lines on October 28. However, they did not close out the permit because they knew that a planned tank moving operation also required the lines to be de-energized. The tank movement also required de-energizing additional overhead electrical lines. The construction coordinator for the tank project changed the original permit to show (1) additional interruption locations, (2) additional work to be performed, and (3) additional equipment, systems, and utilities to be interrupted. The construction coordinator also changed the beginning date of the interruption from October 27 to November 1. The construction coordinator did not request or receive authorization for any of these permit changes. The unauthorized service interruptions caused a loss of power to a sump west of the advanced waste water treatment facility and an air/radon monitoring station.

At the Sandia National Laboratory, a journeyman electrician sent an apprentice electrician to isolate power to roof-top heating, ventilating, and air conditioning units. The apprentice isolated the power at the motor control center by lifting the load-side conductors. He then put yellow tape on the doors of the motor control center and installed a lockout tag with his name on it. On November 3, the journeyman electrician removed the tape and tag and reconnected the load-side conductors without authorization. The apprentice electrician notified his supervisor of the lockout removal.

At the Oak Ridge National Laboratory, workers replacing an air cylinder at the decontamination laundry installed and verified a single-point lockout on October 29. They later stopped work because needed replacement parts were unavailable. On November 3, 1997, OSHA inspectors observed two millwrights installing the new parts and determined they had not re-verified the single point lockout before resuming work.

At the Idaho National Engineering and Environmental Laboratory, maintenance mechanics began a job to install two valves. The work involved installing one valve in an instrument air line and one valve in a plant air line. The mechanics planned to complete work only on the valve in the plant air line on November 3. They planned to install the valve in the instrument air line during a later outage. The mechanics isolated plant air and performed a zero energy check. During the installation operation, one of the mechanics severed the instrument air line instead of the plant air

line. Investigators reported that the lines were correctly labeled. They also believe that the proximity of the two parallel lines and their identical sizes may have confused the mechanic.

OEAF engineers searched the ORPS database for reports involving lockout/tagout events and found 1,835 occurrences DOE-wide. Figure 6-1 shows the distribution of root causes reported by facility managers for these events. Personnel error represented 35 percent of the root causes; management problems also represented 35 percent. Further review of the personnel errors shows that 43 percent were caused by inattention to detail and 43 percent by procedure not used or used incorrectly. A review of the management problems shows that 34 percent were caused by inadequate administrative control and 28 percent by policy not adequately defined, disseminated, or enforced.

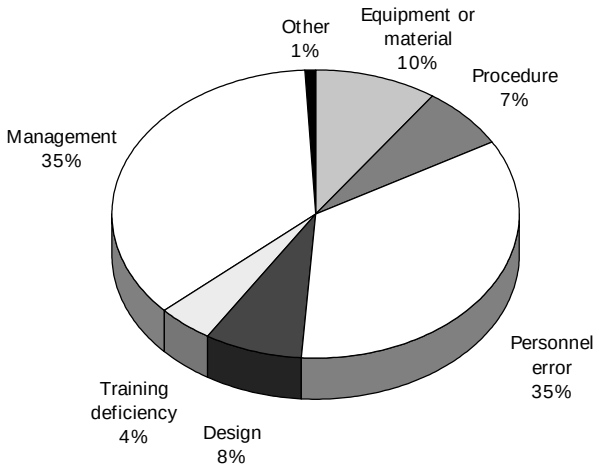

Figure 6-1. Root Causes for Lockout/Tagout Events DOE-Wide[1]

Lockout/tagout programs are essential to ensuring worker safety and to maintaining control over equipment and systems. DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, section 1, "Introduction," states that the primary purpose of lockout/tagout programs is to protect employees from exposure to potential hazardous energy sources. This standard also states that lockout/tagout programs promote safe and efficient operations and are an important element of conduct of operations programs.

DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter IX, "Lockouts and Tagouts," provides specific guidance for lockout/tagout implementation, application, and procedures. The standard states that an effective lockout/tagout requires the following three elements.

- All affected personnel must understand the system.
- The program must be applied uniformly in every job.
- The program must be respected by every worker and supervisor.

[1] OEAF engineers searched the ORPS database for the narrative "lockout or tagout or (lock and tag)" from 1991 to June 1 1997, and found 1,771 reports describing 1,835 occurrences.

The following publications contain pertinent information about lockout/tagout programs and should be consulted by appropriate facility personnel.

- DOE/EH-0540, Safety Notice No. 96-05, “Lockout/Tagout Programs,” summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements.

- DOE/ID-10447*, Construction Safety Reference Guide*, section B.8 discusses requirements for a lockout/tagout program for construction activities and indicates where OSHA training requirements are mandatory.

Safety Notice 96-05 can be obtained by contacting the ES&H Information Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72/Suite 100, CXXI/3, Germantown, MD 20874.

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FUNCTIONAL AREAS: Lessons Learned, Training and Qualification, Work Planning